**Electric Charges, Forces, Fields Summary Sheet**

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| **Electric Charge** | | **Conductors and Insulators** |
| 1. Positive and negative charges 2. Units of Coulombs (C) 3. Electrons are mobile, charge of 1.6 x10-19 C 4. **Positive Ion**: Atom that loses an electron 5. **Negative Ion**: Atom that gains an electron 6. **Law of Conservation of Charge** – charge cannot be created or destroyed 7. **Law of Charges**: like charges repel, opposite charges attract | | 1. **Conductors** allow electrons to flow freely 2. Copper, Aluminum, most metals 3. **Super-conductors**: resistance to electron flow is zero below a certain temperature. 4. **Insulators** do not allow electrons to flow freely. 5. Rubber, plastics, glass, wood |
| **Charging Methods** | | |
| Charging by **Direct Contact** Steps:  1. Obtain an object with an electrical charge (Object A).  2. Touch the charged object with the object that is to be charged (object B).  3. During the contact, the excess charges move from object A to object B.  4. Remove the object A. Object B now has the same type of charge as object A. | Charging by **Induction** Steps:  1. Obtain an object with an electrical charge (Object A).  2. Bring object A near the object to be charged (object B). This "polarizes" object B by moving the electrons to one side.  3. A grounding wire allows electrons to leave object B.  4. Remove the object A. Object B now has the opposite charge compared to object A. | |
| **Coulomb’s Law** | | |
| N where  k = 8.99 x 109 N\*m2/C2  q1 and q2 are point charges (C)  r = distance between the charges (m)  Follows the inverse square law |  | |
| **Electric Fields (E-Field)** | | |
| 1. Charges particles create electric fields. 2. The Electric Field is a vector that is in the same direction as the force a positively charged particle experiences due to other charged particles. 3. Units of N/C |  | |

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| **Electric Field (E-Field) Lines** | |
| **Positive charges:** E-Field directed away from charge | **Negative charges:** E-Field directed toward the charge |
| **Positive and Negative Charge** | |
| **E-Field Line Rules**   1. E-Field lines originate from positive (+) charges and flow into negative (-) charges. 2. The E-Field line at a specific location indicates the direction a positive charge would be "pushed" at that location due to the force produced by the E-Field. 3. Higher concentration of lines indicate a higher E-Field value. 4. E-Field lines never cross. 5. E-Fields from separate charges add like vectors to create the total E-Field due to all charges. 6. E-Fields from separate charges may add or cancel. | |